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CREATING NEW MATHEMATICAL APPLICATIONS UTILIZING SMART TABLE

By

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ABSTRACT

SMART Technologies is leading the way for interactive learning, through their many different tools. The SMART Table is a multi-user, multi-touch interactive interface that not only teaches children different concepts in fun ways (Steurer P., 2003), but it also inspires cooperative competition. In Alabama, the state curriculum for kindergarten through second grade in mathematics education instructs students in the rudimentary manipulation of the base numbers zero through ten (Education 2003). Teachers will greatly benefit from a fun mathematical interactive educational system that involves base numbers. During this project, the authors implemented an educational tool utilizing the SMART Table SDK and Visual Studios 2008 to teach K-2 inequalities and the number line through educational software.

Keywords: SMART Table, SMART Technologies.

INTRODUCTION

A strong education is the key to success and the earlier that students begin building and reinforcing concepts, the greater the chances for students to thrive and excel within the educational system. Elementary schools and early childhood educators are always looking for fun and interactive tools to teach young minds. Mathematics and sciences have a common feature in that they are the least memorable and sometimes hard to understand especially as a young child (Williams, 2009). Teachers will benefit from a fun and easy way to communicate math and science concepts to their students, in vivid ways to help students retain the information for the rest of their lives. SMART Technologies is leading the way in high-performance technologies enhancing the world's way of communication. The SMART Table is a multi-touch and multiuser interactive learning center that allows groups of early education students to work simultaneously on one surface. The SMART Table's interface is so intuitive that even young students can start using it without instruction.

The SMART Table provides users with increased flexibility, both in terms of content and teaching style. Thanks to the SMART Table Toolkit, a resource that comes with the SMART Table, users can create an almost limitless supply of activities for their interactive learning center. The toolkit helps users customize ready-made activities and create new ones. As students learn, teachers refine and redesign activities to keep the children challenged and engaged (Figure 1).

Today's tech-savvy students naturally gravitate to the SMART Table, and its horizontal, 360 degree surface makes it easy and fun for them to collaborate on activities. While working

Figure 1. SMART Table Model 230i courtesy of SMART Technologies

on the interactive learning center, students have the opportunity to build cognitive, social and fine motor skills. Even relatively shy children feel comfortable participating, and show leadership skills when completing group work (Williams, 2009). With its unique and engaging features, the SMART Table is accessible by all students, including those with special needs.

1. Literature Review

In this day and age there are numerous interactive displays. A feature that is becoming very popular is called Multi-touch. Multi-touch can be thought of as a virtual environment because the user is interacting with a surface by manipulating objects as seen in Figure 2.

The displays associated with SMART Technologies are becoming the latest trend in style. SMART Technologies has designed a Smart Table shown in Figure 1 to extend the use of multi-touch technology. The smartable design is in line with a research done at RWTH Aachen University in Germany and the University of California, San Diego investigating the Silicone iLluminated Active Peripherals (SLAP) concerning table tops. SLAP is system of observable, translucent widgets for use on multi-touch tabletops. SLAP can be considered as a type of input devices that brings together the advantages of using physical and virtual on-screen widgets. SLAP Widgets can emerge from silicone; they can also consist of acrylic, and include sliders, knobs, keyboards, and buttons as shown in Figure 3.

Though the development of multi-touch technology has led to the rise in popularity of virtual keyboards, they are

Figure 2. Users interacting with a Multi-touch

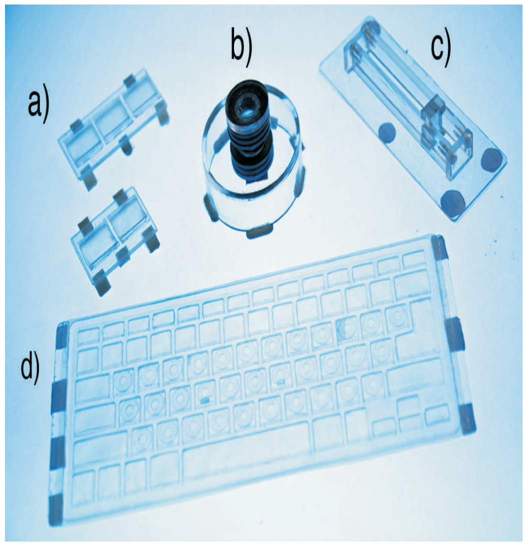

Figure 3. SLAP Widgets. a) Keypads. b) Knob. c) Slider. d) Keyboard courtesy of SLAP

poor in comparison to the haptic feedback offered by standard keyboards. As a result some complexity takes place for typists who concentrate on the feeling of controlling the keyboard to guide the input of text. The SLAP Keyboard seeks to reduce the concerns that virtual keyboards brought about, in conjunction with going over and above the capabilities of multi-touch technology. Along as there is a surface, the widget can be placed wherever, all a user has to do is allow the widget to work in collaboration with an application and enter in text similar to the experience you would undergo to the same degree as utilizing a keyboard as shown in Figure 4.

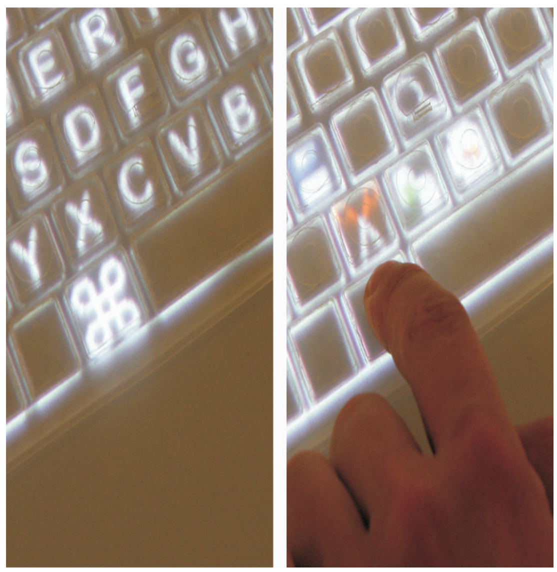

Figure 4. User using Slap Keyboard courtesy of SLAP Widgets

A multi-touch table provides a technique of communication for sensing physical SLAP Widgets dealing with presenting the virtual objects such as images and text that they modify. The user will notice the reaction that SLAP sends to multi-touch tables. This SLAP technology has been great for improving input accuracy upon the tables. By using the technique of rear projection, SLAP Widgets can be relabeled vigorously which will present inexpensive, battery-free, and unlimited augmentations. The aspects of their table include a blend of infrared technologies by the use of a single camera with an infrared filter and computer vision software to recognize surface pressures and reflected light. The software architecture of their system shown in Figure 5, consists of the multi-touch framework, the SLAP User Interface Toolkit, and the application (Weiss M., 2009).

Long-ago if a designer wanted to create a design they only had a keyboard and lines of text to accomplish their task. The mouse supported the next generation of interaction and it provided support to a very well developed system design in unison with a two-dimensional surface of a user interface.

During this current generation multi-touch and gestural interfaces are on the market. Interaction designers and the interface research community interested in learning more about these features can acquire these devices. You don't have to be involved in a research project or lab to use this cutting edge technology. Anyone can take advantage of these technologies; a user has the ability to develop new, distinctive design patterns and approaches. On the contrary to the way these new interfaces function, there are new obstacles and patterns, which have increased the complexity of user interface design along with the multitude of hardware devices that have had an influence on the interface. At this point in time, an enormous amount of research and commercial activity has been invested in multi-touch systems. Researchers have made an effort to explore different sensing technologies as well the design of interaction methods.

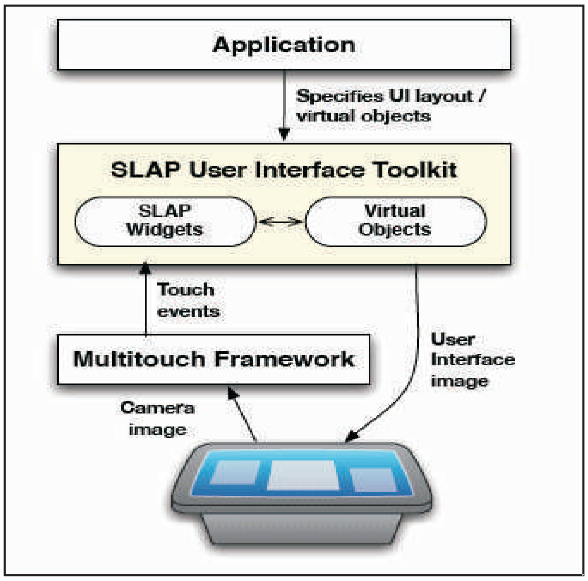

Figure 5. SLAP Software architecture courtesy of SLAP Widgets

Along with the increase of devices and interfaces, results in an unfavorable growth of uncharacteristic design patterns and approaches toward user interaction. Even as multi-touch and gesture-based interaction have provided further enthusiasm for designers, a significant amount of attention needs to be invested into how touch interfaces are developed and to investigate various interfaces across countless surfaces such as mobile, desktop, laptop, and broad surfaces. Some fundamental designs have begun to come to light across multiple devices for interactions. These designs include quick movements with a 'finger spreading' gesture, and direct movements with a single finger moving smoothly across the display.

Techniques have emerged on the subject of how touch and gesture are built-in to computing systems. Systems, similar to the Apple iPhone draw attention to touch as the only method of interaction. Others systems such as the Windows 7 operating system, endorse a collection of input methods such as touch, stylus, and keyboard/mouse. Camera systems and capacitive technologies are the basis for some devices. Additionally these technologies can prompt multiple design methodologies based on the assortment of capabilities relating to the device. Apple's track pad has been acknowledged for using multiple gestures. Apple's track pad uses a four finger touch gesture. Larger devices such as Microsoft Surface and the SMART Table are capable of simultaneously tracking greater than 50 contact points (Daniel Wigdo, 2009).

2. Motivation

Many mathematics and science educators have strived to

deliver excellent teaching in fun ways, but their methods can benefit from more creativity, new device platforms, and novel interaction techniques. To enhance fun learning techniques especially to younger aged children is a great way to inspire school and education. Along with fun learning techniques, it is important to break down the curriculum to explore exactly what subjects will benefit from more interactive presentations to children. A few of those subjects are in the STEM field, science, technology, engineering and mathematics. To build up basic mathematical reasoning skills in younger aged children is a common motivation in SMART Table accesses. It is also a good concept to have a fun and fact-based activity with hands on experiments, this helps insure memorization and interaction with others.

3. Design One

Design one is the main focus of SMART Table Access, this design is the first scenario or game that involves basic practical mathematical concepts that are usually taught at an early age. Some Mathematical concepts include the vocabulary terms of less than, greater than and equal (Fink, 2009) (Education 2003) to and are the ideas behind this game design, at least for the elementary stage of the SMART Table program.

The signs as you already know are important in many ways in life but the focus is strictly with the numbers 0-10. In Alabama the basic curriculum for Kindergarten through second grade is where the introduction of the "Inequality signs" actually begins. The 0-10 numbers are also essential in this game because the authors are focusing this application on the K-2 children and greater numbers are not introduced in this way till the latter part of second grade (Education 2003).

These are the important signs to know:

$=$ If two values are equal, we use the "equals" sign

Example: $2+2 = 4$ $\neq$ If two values are definitely not equal, we use the "not equal to" sign

Example: $2+2 \neq 9$ $<$ But if one value is smaller than another, we can use a "less than" sign.

Example: $3 < 5$ $>$ and if one value is bigger than another, we can use a "greater than" sign

Example: $9 > 6$

The base numbers are an ease as far as just counting on one's fingers is concerned, but when a child is asked to show how one number zero through ten is greater than another number zero through ten, the child then has to know of other ways of explanation (Education 2003). Hence where the inequalities game could be that solution. Inequalities have been around and a part of the education curriculum for a long time now. Only some inequalities actually came from ancient traditions, but the famous and more complex inequalities came about after Isaac Newton found his laws (Fink 2000) (Figure 6).

The game is also a type of cooperative competition instilling that children need to work together to come up with the appropriate solution that is accepted. This theory is one of SMART Technologies main concepts that they are trying to incorporate into all of their products. Competition is always a good way to learn something, but invoking camaraderie with that competition is just a healthier and interactive way of learning (Steurer P., 2003).

4. Implementation of Design One

The SMART Table Inequality Signs game is first introduced as a "Welcome Screen" with a short tutorial for explanation purposes of the game. Along with the number line icon, there will also be a star game or Press here selection. This part has several objectives, first is to recognize how many players there will be playing the game, second to make sure that all players are ready to begin the game simultaneously, and third to actual begin the game. The Welcome screen will be a border canvas and text screen (Figure 7). The start button will be a draggable border that

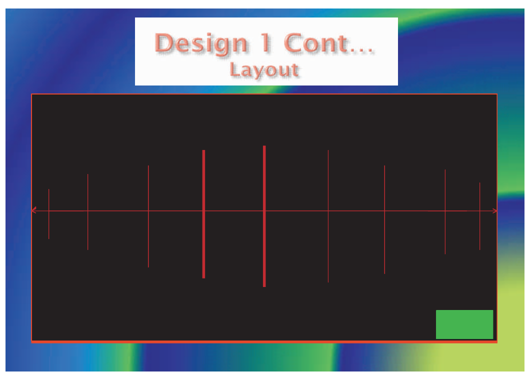

Figure 6. Smart Table Caption – Layout

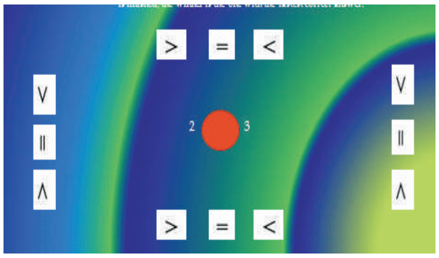

Figure 7. Calculators-ME- Layout

Figure 8. Hungry Whale - Layout

moves around the canvas of the SMART Table, recognizing touches. This button will also have to become a sequence button which is a simple touch button from the SMART Table library icons. The number line is just an icon used for reference and detail purposes (Daniel Wigdo, 2009).

The game begins by dropping two random numbers 0-10 on each side of a centered acceptance circle. Around the outside or borders each player will have the ability to drag inequality signs.

These signs will be inserted icons used for the answer choices to the questions. The players will be able to choose their own answer and drag it to the circle in the center. If the answered inequality sign is correct then it the game will accept the answer; if it is wrong the game will just kick it out until the correct choice is selected. There is also an internal timer keeping a time interval of all the users' answers as well as the time it takes the winning player to select the right answer. This data is going to be shown in the game summary page that follows the question 1 problem.

Only when all players have selected the right inequality will a star appear, stating they are correct and then the square will appear again in the corner to be able to go to the next question. There will also be a timer in the game, to let the players know who won the game. It doesn't show the winner of the round until each round is finished; the winner is the one with the fastest correct answer. This is the game summary page. If the users want to play again the same rules and outlines will apply.

// Design Two

// Hungry Whale

// Calculator-ME

Three types of tests will be conducted.

Test Alpha

This is a basic skills test. This test is designed for the kindergarten through second grade to ultimately test the children's knowledge base of mathematics (Figure 8) to assess whether the game application is age appropriate for young students. Take into consideration: different childhood schools and surroundings, parent-child home life, special needs children, and gifted children.

These considerations will just be advised. Future work will actually input the different scenarios.

Test Beta

After Alpha has been processed and an understanding of the childhood mathematical education is developed Test Beta will be conducted. Beta is a Pre-Test to the SMART Table Application game of the inequalities; it is useful to know how the children will react to the game.

Test Omega

After the first two tests have been reviewed. The children are given the SMART Table application, with the inequality game. After these preliminary tests are completed, the research team will begin utilizing the SMART Table application in the field for a longitudinal study with elementary school students. The students will not only play with the SMART Table and learn how to use it and they will play the inequality game to learn more about inequalities. We will test system acceptance, system usability, compare the usability of this application with PC or multi-touch devices and test student's mathematical learning with a comparative study of the application and in comparison with another statistically similar class that will not be presented with the software application.

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